

Isolating detector crosstalk events in the weakly interacting massive particles consistency region of the Super Cryogenic Dark Matter Search

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Abstract

Despite the ample evidence that dark matter makes up approximately 85% of the matter in the universe, it has never been detected directly. The Super Cryogenic Dark Matter Search (SuperCDMS) is looking for weakly interacting massive particles (WIMPs) that may interact with germanium nuclei. ^{133}Ba multiples data, in which two signals occur simultaneously on different detectors, can be used as a proxy for studying the γ -interactions in low background data. However, capacitance between detectors in SuperCDMS can cause a large charge signal on one detector to generate a smaller, negative pulse on an adjacent detector. If the crosstalk from a neighboring detector reduces the charge signal by enough to reduce the ionization yield significantly, it can look like a nuclear recoil and impede the definition of a WIMP search region. We show that charge crosstalk occurs on the order of 0.5% of the primary signal, then develops a cut to identify events being affected by crosstalk and assesses its efficiency for identifying crosstalk events in outliers in the consistency region for barium calibration data. By requiring that 10% of the actual charge amplitude exceed the crosstalk amplitude we define a robust selection criteria for selecting events. With the removal of these events, the true barium multiples can be used to study the behavior of γ -interactions and define a search region for low-background data.